



9 ROXBURY ROAD SCARSDALE, NEW YORK

Introduction

Durable, versatile and functional, steel casements were a popular window type throughout the first half of the twentieth century. They were simultaneously modern and traditional, easily adapted to fit the variety of eclectic architectural styles that appeared during the period. Benefiting from steel's strength, casements featured slender profiles that provided a lightness and delicacy unmatched by other window forms. They also admitted large amounts of sunlight and ventilation to the interior. Steel casements were widely distributed by a number of manufacturers including Fenestra, David S. Lupton & Sons, and Hope's of Jamestown (the latter of which is still in business), until the windows fell out of favor in the years after World War II. High quality steel, combined with the window's simplicity and solid construction, helped many survive three quarters of a century of use, wear, and often, neglect.

Casement windows are an important design element of the Tudor Revival house at 9 Roxbury Road. Built in the early 1920s, it is a common house type

found within the neighborhood and among other suburban communities that date to this era. The sixty-five steel windows are placed individually, in pairs or in bands of three or four along the masonry and stucco exterior (*see figure 1*). Each of the Fenestra brand windows contains six lights in two vertical rows with the panes putty-glazed on the outside. The historic glazing was double-strength glass with noticeable, though not prominent, distortions (*see figure 2*). Hardware, consisting of a locking handle and sliding "lift and stay" operator with brass pin, was both functional and decorative, providing subtle embellishment along the inside of the window (*see figure 3*).

Problem

The windows on 9 Roxbury Road showed deterioration and damage typical of historic steel casements. In the course of over seventy-five years, corrosion, wear and some distortion of the sash and frame had occurred. Rust was particularly prevalent along the lower parts of the sash and frame where water had penetrated the distorted opening and the cracked perimeter

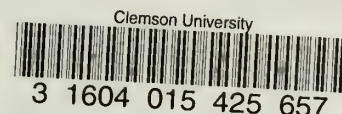
PRESERVATION

Tech Notes



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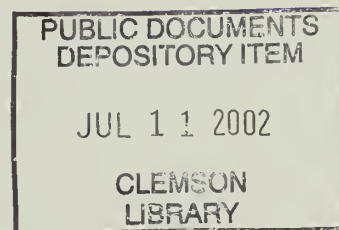
WINDOWS

NUMBER 19

Repairing Steel Casement Windows

Chad Randl

Technical Preservation Services
National Park Service



Steel casement windows should be repaired rather than replaced whenever possible.



Figure 1. Steel casement windows were placed in various configurations throughout the house. Grouped windows open in opposite directions from each other, assuring that breezes can be captured, and a sash opened during rainy weather, regardless of the wind direction.



Figure 2. Each casement sash had six lights with projecting hinges that allowed the unit to open outward. Note the variation among glass panes as seen in the reflections. Caused by small differences in the positioning of panes within the sash and minor imperfections in the glass itself, this appearance is an important characteristic of historic windows.

caulk (see figure 4). Originally tight fitting, all of the sash were bent out of alignment with resulting gaps from 1/16" inch to 3/4" inch between sash and frame. Hardware was corroded, stiff, and in some windows, seized shut. Prior attempts to force the distorted windows closed had also bent some of the locking handles and other hardware.

Ten windows were completely inoperable either because they were so far out of alignment that they could not be opened and closed or because successive layers of paint had sealed them shut. When a previous owner installed window-mounted air conditioners not designed for steel sash, four additional windows were modified and made inoperable.

Exterior glazing putty that helped secure and seal the glass in the window sash was deteriorated in many areas. Furthermore, some of the horizontal muntins along the room side of the sash were missing back putty that had cracked and fallen out. As expected with windows of this age, most sash showed signs of repeated patch attempts at reglazing and repainting. Resulting profiles lacked the crisp bevel that is characteristic of steel casement windows. Successive reglazing and repainting efforts had crept further out onto the glass (especially along the inside surface), increasing sightlines well beyond the 3/4" width of the historic glazing bars.

Solution

The owner had purchased the house at 9 Roxbury Road, in part, because of its historic appearance. As an architect interested in older buildings, the owner recognized the importance of steel casement windows in helping to define the building's historic character (see "Steel Windows and Historic Character" sidebar).

When the windows deteriorated to the point where major repairs were required, the owner sought the least intrusive solution. Having seen other houses where casements had been replaced, it was clear that new aluminum, wood or vinyl units would not share the same dimensions, profiles and craftsman-

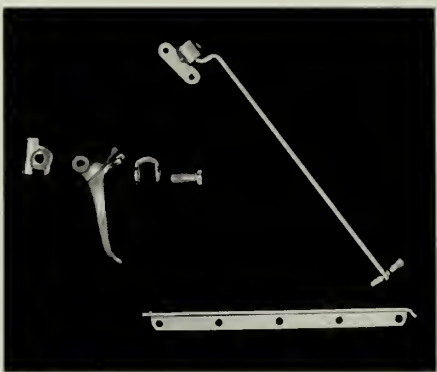


Figure 3. The window hardware at 9 Roxbury Road included a two-part "lift and stay" operator (right) and a common locking handle (disassembled at left). The hinged portion of the lift and stay (upper right) is attached to the sash while the perforated length is connected to the frame. To open the window, the pin is lifted from the hole on the far right, the sash is pushed open and the pin reset in one of the adjacent holes.

ship of the historic windows. While replacement with new steel casements was an alternative, saving most or all of the historic windows, if possible, was the preferred preservation solution.

The owner contacted a window repair company that had over twenty years of experience repairing and servicing steel casement windows. After an initial inspection of the windows, a plan was drawn up for their complete rehabilitation. Much of the work would consist of realigning the bent sash and frame, thus returning them to their original tight fit. All the hardware would be serviced to make locks secure and to allow the hinges and other mechanisms to move without resistance. Additionally, broken parts were to be replaced with like materials from the repair company's stock. The

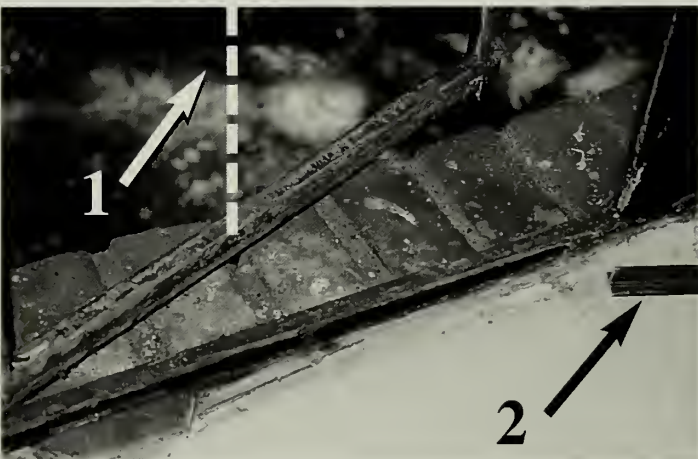


Figure 4. The sash and frame were most severely corroded along lower, horizontal members. A vertical glazing bar had previously been removed from the sash above to fit a window air conditioning unit (1). A replacement "T"-shaped length of steel that will be spliced in can be seen on the right (2).

Steel Windows and Historic Character

Whether Tudor Revival or International Style, Collegiate Gothic, Mission or Art Deco, steel casement windows had a place in many of the stylistic trends prominent in the years prior to World War II. Buildings based on medieval forms used steel casements to recreate traditional European windows.

Modern architects, already partial to steel, found that ribbons of single-light casements matched their industrial aesthetic. The adaptability of steel casements also extended to a variety of building types and sizes, including small cottages and ostentatious mansions, schools, hospitals and apartment buildings. Frank Lloyd Wright's Fallingwater and the thirty-story Drake Tower in Philadelphia, though very different in scale and style, both featured steel casement windows as an important design element.

Regardless of a building's style or function, steel casement windows are often a crucial, "character-defining" feature. The muntin patterns of steel casements complement both the orientation of the window openings and the arrangement of windows in multiple groups or bands. Thin profiles form a pleasing contrast to the heavy masonry, brick or stucco walls in which they were often set. The aesthetic appeal and functional value of casements is enhanced when the units are opened, allowing maximum ventilation, and in those units with divided lights, emphasizing variations in the individual windowpanes.

Because casement windows figure prominently in a building's visual appearance and contribute to its historical character, any rehabilitation project should first attempt to repair the existing units. Unfortunately, replacement windows often do not match the his-

toric windows. Replacements may be incompatible in material, dimensions, muntin arrangement or color. Any one of these changes can have a negative



Inappropriate replacement windows dramatically affect the appearance of a historic home that once featured steel casement windows.

effect, and may compromise the historic value of the entire structure. This *Preservation Tech Note* suggests methods that can be successfully used to repair steel casements. In rare cases where the historic units are beyond repair, replacement windows should match as closely as possible the design and appearance of the original casements.



Historic steel casement windows are in the process of being replaced with new units that compromise the character of this building facade.



window-mounted units were to be removed from the four affected windows and the damaged areas of the sash and frame rebuilt with lengths of steel that matched the existing profiles.

A separate painting company with extensive experience in painting historic steel windows would remove corrosion and repaint and reglaze the windows. As part of the planning, the paint contractor visited the site to evaluate the condition of the windows and discuss the work schedule. It was

decided that after the windows were repaired and serviced, the company would strip existing paint and built-up rust, replace cracked or severely scratched glass panes, reputty as needed, and then repaint the windows.

Window Repair

Each window presented a different set of repair challenges depending on where it was located on the house, how often it was used, and whether it had

previously been altered. All required some degree of realignment and servicing. Unless a sash was severely corroded or replacement steel sections required, glass was not removed from the sash for any part of the repair process.

A two-person team undertook repairs one room at a time, usually from the inside of the house. To protect interior spaces and furnishings from paint chips, dust, lubricating oil and primer, the crew taped plastic sheeting along the affected areas. When necessary, workers also



Figure 5. Before realigning the window, paint, caulk, weatherstripping and rust were stripped from all surfaces where the sash and frame were in contact.

accessed the windows from the outside, either on the ground or by a ladder scaffold. In this case, plastic sheeting was hung vertically in the interior. The work was undertaken during the day, while the homeowner was away. Before evening, work areas were cleaned up and protective sheeting was removed so that the process had little impact on the owner's household routine.

After protecting the work area, layers of paint, rust, caulk and weatherstripping were scraped from all contact surfaces where the sash meets the frame and where locking pieces meet (see figure 5). Such extraneous material had to be removed before attempting to realign the window, so that the severity of distortion could be accu-



Figure 6. Pull bars were used to realign the sash from the inside. These custom made tools were especially useful on single sash units where the worker was unable to reach through an adjacent opening to apply pressure from the outside.

ately determined and the repairman could tell when a correct fit was achieved. Using metal shims of varying thickness placed between sash and frame, the worker then began the realignment process by gently applying pressure to the sash. With the shims acting as levers, one location was pushed in while another was pulled, to bring racked corners and warped planes back into alignment. Where the sash was bent outward on either the top or bottom, it was gently twisted back into shape. On single windows, where there was little room to reach out and manipulate the sash from the inside, various pull bars custom-made of notched aluminum rods were used (see figure 6). When the sash was aligned, bent locking pieces and other hardware were similarly returned to their original shape or, where broken, replaced with identical pieces.

The fit of sash against frame and the ease of movement in the hardware was tested throughout the process by opening and closing the window. Frequently gauging the progress prevented overadjustment. Care also had to be taken not to break hinges, handles or glass. The experienced repair team's under-

standing of the characteristics and tolerances of steel windows prevented such mishaps on this project.

When a close fit had been achieved and the window opened and closed freely, servicing began. Paint was scraped from hardware joints and contact points. Locking handles that did not function smoothly were disassembled, cleaned, adjusted and reinstalled. Loose handles were tightened. Dirt was removed from hinges and operators and then all working parts were lubricated. After repair and servicing were completed, areas of the window that had been stripped of paint were coated with an oil-based primer. This protected the bare metal from corrosion until the entire window could be repainted in the next phase.

Fortunately, most of the hardware at 9 Roxbury Road was generally in working order. Window repair projects that encounter broken hardware have several options. Minor damage, such as bent sliders or hinges, can often be repaired either in place or after removing the pieces to a workshop. If these working parts are damaged beyond repair (or missing), replacements can be obtained from dealers in salvaged,



Figure 7. New steel sections were brazed into the historic sash and frame where the windows had previously been altered to fit air conditioning units. Because the replacement pieces came from a stock of salvaged window materials, they matched perfectly the profiles and dimensions of the missing sections.



Figure 8. A pneumatic needle gun was used to strip much of the paint from the steel frame and sash. It was followed by wire wheel and small disk sanders and hand chisels. The blunt tipped needles did not damage the steel or adjacent glass.

or new, replicated hardware. See <http://www2.crnps.gov/tps/ptm45/material.htm> for a list of possible replacement material sources.

In order to repair the four windows previously altered for air conditioning at 9 Roxbury Road, it was necessary to replace missing metal sections along the lower third of the sash and frame. Lengths of replacement steel with the typical “Z” and “T”- shaped profiles were obtained from a stock of salvage material maintained by the repair company. Exact matches were easily achieved because replacement pieces came from identical Fenestra casement windows of the same period. To rebuild the sash, replacement steel bars were held to the existing sash with clamps and brazed together with an oxygen-acetylene torch (see figure 7). After



Figure 9. An oil-based putty was used to reglaze the historic casement windows. Painting was undertaken two weeks after reglazing.

cooling, the brass seam was ground down with a sander so that it was flush with the existing surface. Though not necessary in this project, a similar treatment can be used when portions of the frame or sash are corroded beyond repair. In such a case, damage is usually limited to the frame, sill and lower portions of the sash, where unattended water problems lead to severe oxidation. The deteriorated section can usually be cut out and new pieces from salvaged stock brazed into place.

When the steel windows were properly aligned, the “Z”- shaped bars of

the sash and frame fit together in a near weathertight configuration. As a result, weatherstripping was deemed unnecessary. In the past, however, as casement windows on the house had become misaligned and air and moisture infiltration increased, previous owners did add a variety of weatherstrips. Placed along the hinge side, the additional material acted as a shim, putting stress on the locking handle and hinges by holding the sash open on the locking side. A damaging cycle ensued as thicker weatherstrip was added in an attempt to close the widening gap, and the windows became increasingly distorted as the owner tried to force them shut. Eventually, problematic windows were simply never opened.

If weatherstrip is used on rehabilitated casement windows, care should be given to its placement in relation to the window’s operation. The thinnest possible material that does not retain water or spring the hinges should be selected. One weatherstrip that has been used successfully with casements is a sealant bead. In this system, a silicone bead is applied to the frame and the sash contact surface covered with a non-stick tape. The sash is then closed and the bead allowed to set in the shape of the space between sash and frame. More information about weatherstripping and steel windows is contained in *Preservation Brief 13*. “The

Health Considerations

As with many old and new building materials, potential hazards exist in historic steel windows that require careful handling. Lead-based paint is likely among the built-up paint layers found on casements, while some glazing putty manufactured after 1930 for a time contained asbestos fibers. At a minimum, removing these materials requires the use of HEPA-filtered half-face respirators by workers, as well as covering the affected area with six mil polyethylene sheeting, and vacuuming dust and chips with a HEPA-filtered vacuum. The degree of protection required is determined by the manner in which potentially hazardous materials are removed; techniques that limit the spread of dust and do not make asbestos friable present fewer risks. Depending upon the type of work being done, the size of the project, and the jurisdiction of differing state laws and local ordinances, a certified contractor may be required to remove and dispose of these materials. *Preservation Brief 37*, “Appropriate Methods of Reducing Lead Paint Hazards in Historic Housing,” as well as local environmental offices, the EPA and OSHA can provide additional information.



Figure 10. Detail of complete windows, repaired, serviced, reglazed and repainted.

Repair and Thermal Upgrading of Historic Steel Windows."

Stripping, Reglazing, Painting

Arriving after the windows have been completely repaired, adjusted and serviced, the paint contractor stripped old layers of paint from the windows, replaced deteriorated glazing putty and broken glass and reglazed and repainted each of the windows. Before any work was undertaken, plastic sheets were placed below the windows on the exterior and hung vertically along adjacent interior spaces. The sheets captured paint, rust chips and old putty so that they could be safely discarded (see "Health Concerns" sidebar).

Deteriorated putty was removed with a utility knife and small chisel. Back putty that had crumbled or lost its adhesion was removed from the inside face of the sash using a small chisel and vacuum. Because individual panes were not removed unless previously broken, extreme care was required to clear old putty from the sash without damaging the historic glass. Removing the pane would have required prying it free of the remaining putty, a process that is extremely difficult to achieve without breakage. Having been protected by the glass and putty, the glaz-

ing bar beneath this area was usually in good condition; any minor rust patches were sanded by hand and then primed.

Initial paint and rust removal was done with a pneumatic needlegun. When set to a standard air pressure, the needlegun neither pitted the steel, nor damaged adjacent glass (see figure 8). Occasionally an air hammer with a blunt end attachment was also used. The needlegun was followed by a sander with wire wheel attachments. Run the length of each steel member, this tool removed almost all of the remaining paint and most of the rust. It was especially useful in clearing pockets of rust from crevices and gently grinding down the more severely pitted surfaces. Removing rust with a sander was preferred over sandblasting because a sander is less messy, does not require shielding the glass and masonry surround, and is less likely to damage the steel. Finally, a small hand chisel and sandpaper were used in corners, on the inside edges of the hinges and in other tight locations not reachable with larger tools. Because they were used as guides for the application of the new putty bevel, it was essential that the edges of the muntins were free from nicks or bumps that would have resulted in an uneven profile.

After the sash and frame were stripped, a primer coat was immediate-

ly applied to the steel to prevent oxidation of the bare metal. The reglazing process then began. Approximately six percent of the historic glass panes were cracked or severely scratched prior to the beginning of the project. Damaged panes were replaced with standard double strength (1/8" thick) window glass. Alternately, the owner could have used a reproduction glass with a slightly distorted appearance that resembled the historic panes. However, the small number of new panes required meant that replacement flat glass would not be overly noticeable among the historic material.

The glazing contractor used natural, oil-based (linseed or soybean) putty that remains relatively soft. Putty was repacked along the interior face first. In keeping with the historic appearance of the windows, all putty lines on the inside were run flush with the muntin, so that no bevel profile was present. This brought sightlines back to the narrow appearance that is so characteristic of historic steel windows, while creating a watertight seal that keeps condensation from entering the joint. Putty was then applied along the exterior in a beveled profile that helps shed water (see figure 9). Finally, the glass was carefully cleaned with a four-inch razor blade followed by a standard glass cleaner.

Although the manufacturer states that the putty can be painted the day after application, the painting contractor preferred to allow two weeks for the putty to cure sufficiently. Two finish coats were applied to the frame, sash and glazing putty. The industrial paint, a brand commonly used on steel bridges, was custom mixed a taupe color to match the exterior wood trim. To form a moisture resistant seal, paint was extended a small amount beyond the putty and onto the glass face – a standard practice, both past and present.

Evaluation

Steel casement windows that are in good working order tend to stay that way. If they function without resistance, excessive (and often damaging) force is not required to operate them. When windows are used and receive attention, eventual repair needs are more quickly identified, before they grow severe. While sound windows remain sound, steel windows that are in poor condition usually deteriorate at an accelerated rate. Problems often



Figure 11. The completed work reveals the aesthetic appeal of the historic casement window – qualities appreciated both past and present.

begin with lack of maintenance. If the hinges or locking hardware become stiff and the window resists opening or closing, owners try to force the window, causing it to bend out of alignment. As alignment problems are aggravated, the window becomes harder to operate and the space between the sash and the frame widens, allowing unacceptable levels of air and moisture infiltration.

Repairing the historic steel casement windows at 9 Roxbury Street preserved a significant feature of the house, one that is important to the exterior appearance as well as the interior. With the removal of deteriorated paint and putty and a return to original narrow sight-lines, the historic look of the windows was enhanced rather than diminished (see figures 10 and 11). Window perfor-

mance was increased through servicing and realignment, as the tight manufacturing tolerances between sash and frame were restored. The work was done in a timely manner, with no effect on surrounding historic material. Of equal importance, the sixty-five windows were repaired and reglazed for less than the cost of comparable steel or aluminum replacement windows.

Due to the high structural strength of steel, replacement sash of other materials (wood, aluminum, vinyl), rarely, if ever, can match the narrow members of the original sash. Additionally, installing replacement windows may require removal of the historic steel subframe and cause damage to plasterwork and exterior masonry. If replacement windows are

set within the existing subframes, the glazed area of the window may need to be reduced by up to twenty percent, greatly altering the appearance of the opening and reducing the amount of light reaching the interior. Furthermore, modern glass that accompanies replacement units will not replicate the slight variation that exists between the original panes of a historic window.

Even when historic steel windows are not severely deteriorated, they are often targeted for replacement because of the desire to increase energy efficiency. Though good double glazed replacement windows will provide better thermal performance and lower energy costs than historic steel windows alone, any energy or cost saving calculation must include other factors not usually acknowledged. True replacement costs should include the expense and inconvenience of removing the historic units, the need to repair resulting damage to the window surrounds and the cost of the replacement units themselves. Such considerations are particularly relevant in light of the fact that homes are often owned for increasingly short time periods before being resold. Additionally, a shorter lifespan should be assumed for the replacement units, as the insulating glass units that accompany new windows will eventually fog and require costly replacement.

Assemblies have been developed that increase thermal efficiency while allowing the preservation of significant historic windows. The most common approach is to install storm windows. Because casements swing outward, the storms are almost always placed on the interior. Where casements are paired, inexpensive horizontally sliding storm windows can be installed on the inside. This arrangement allows full access to each sash so that they can be operated and maintained. Although full ventilation for which casements are prized is partially restricted, the level of airflow is still comparable to a typical double hung window. Storm windows can be extremely cost effective and can have little visual impact when they are installed properly and given an appropriate (typically dark color) finish. For a more detailed discussion of how storm windows can be applied to casements, consult *Preservation Tech Note*, "Windows Number 15. Interior Storms for Steel Casement Windows."

Another alternative to wholesale replacement of steel windows is the

[illegible]

The historic steel windows at 9 Roxbury Street survived over seventy-five years of weather and wear. Their longevity attests to the strength of the material and the quality of their construction. Though significantly deteriorated, the owner chose to repair the historic windows rather than replace them. After realignment, reglazing, cleaning and repainting, the windows offer a continued lifespan that is hard for any replacement window to match. The benefits are doubly visible. On the outside, the house retains its historic look with appropriate windows with appropriate muntin divisions and profiles. On the inside, the narrow sightlines permit a large amount of light to enter the room, and the beauty of the window's craftsmanship is apparent.

Building:
9 Roxbury Road
Scarsdale, New York

Owner:
Chris Keeny

Project Date:
Fall 2001

Window Repair:
Seekircher Steel Window Repair
Scarsdale, New York

Window Stripping, Reglazing and Repainting:
Patriot Restorations
Scarsdale, New York

Project Cost:
The total cost for rehabilitating the sixty-five steel windows at 9 Roxbury Road came to approximately \$23,500 total or \$360 per window. This included approximately \$4,000 for realigning and servicing, rebuilding missing sash sections, and replacing hardware. The remainder included stripping, reglazing and repainting all of the windows, as well as the necessary replacement glass.

Photos in “Steel Windows and Historic Character” sidebar are NPS file photos. All other photos are by the author.

PRESERVATION TECH NOTES are designed to provide practical information on traditional practices and innovative

techniques for successfully maintaining and preserving cultural resources. All techniques and practices described herein conform to established National Park Service policies, procedures and standards. This Tech Note was prepared pursuant to the National Historic Preservation Act, which directs the Secretary of the Interior to develop and make available to government agencies and individuals information concerning professional methods and techniques for the preservation of historic properties.

Comments on the usefulness of this information are welcomed and should be addressed to PRESERVATION TECH NOTES, Technical Preservation Services – NC200, National Center for Cultural Resources, National Park Service, 1849 C Street, NW, Washington, DC 20240.